



IDENTIFYING DATA

Electromagnetic Transmission

Subject	Electromagnetic Transmission			
Code	V05G300V01303			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Vera Isasa, María			
Lecturers	Aguado Agelet, Fernando Antonio Arias Acuña, Alberto Marcos Díaz Otero, Francisco Javier García-Tuñón Blanca, Inés Gómez Araújo, Marta Lorenzo Rodríguez, María Edita de Rubiños López, José Óscar Santalla del Río, María Verónica Vazquez Alejos, Ana Vera Isasa, María			
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General description	Fundamentals of electromagnetic guided and unguided transmission. Analysis of the operating principles of different transmission media models and their characterization in telecommunication engineering.			

Competencies

Code	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
A17	CE8/T3: The ability to use software tools for bibliographical resources search or information related with electronics and telecommunications.
A18	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
A22	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
A29	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.

Learning aims

Expected results from this subject	Training and Learning Results
To understand the mechanisms of propagation and transmission of electromagnetic waves.	A3 A22
To identify and define the main parameters that characterize transmission media of electromagnetic waves.	A3 A17 A18
To solve problems that require the handling of basic concepts related to guided and radio transmission.	A4 A22

To estimate transmission losses in different media.	A3 A5
To measure antenna basic parameters.	A5 A18 A29
To search updated information about specifications and regulations.	A3 A17 A29

Contents

Topic	
1. Introduction	Types of transmission media, advantages and disadvantages, characterisation.
2. Transmission lines	Getting started with some of the most commonly used transmission lines: coaxial, twisted pair. Circuit model of distributed parameters ,general equations, characteristic parameters (characteristic impedance, propagation velocity, attenuation and phase coefficients). Attenuation, dispersion and crosstalk. Transmission line in circuit (reflection coefficient, standing wave ratio, input impedance). Smith Chart.
3. Waveguides and optical fiber.	Rectangular waveguide: TE and TM modes, cutoff frequency, guided wavelength, wave impedance. Optical fiber: structure, types, numerical aperture, acceptance cone , attenuation and dispersion.
4. Radiowaves and antennas	Characteristics of radiowaves: far field, radiation integral. Antenna concept and fundamental parameters (radiation pattern, secondary lobe level, beamwidth, directivity, gain, polarisation, impedance). Reception: power balance in free space (Friis equation), polarization loss factor. Center feed dipoles. Radiosystems evaluation.
Labs	- Management of software tools to search information: technical, scientific and regulation of telecommunications. - UTP and coaxial. - Basic matching technics. - Radiation pattern plots. - Measurement of basic parameters in transmission lines, waveguides and antennas. - Problem resolution.

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	2.5	3.5
Master Session	17	25.5	42.5
Laboratory practises	12	6	18
Practice in computer rooms	8	4	12
Presentations / exhibitions	2	16	18
Autonomous troubleshooting and / or exercises	12	24	36
Troubleshooting and / or exercises	2	8	10
Multiple choice tests	2	8	10

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Introductory activities	Activities focused to take contact and get information about the students and to introduce the subject.
Master Session	Presentation by the teacher of the contents of the subject of study (theoretical basis). Learning aims T4, T8 and CG3.
Laboratory practises	Application of knowledge to specific situations and acquisition of basic skills and procedures related with CG5 aim. They are developed in laboratories with specialized equipment.
Practice in computer rooms	Activities of acquisition of basic skills related with the matter. Learning aims T3 and T15 are specifically worked with this methodology.

Presentations / exhibitions	Student presentation of the results of a group work about T15 aim.
Autonomous troubleshooting and / or exercises	Activity in which problems are formulated related to the subject. The student must develop the analysis and solving problems independently. The solutions are provided in ordinary class hours. Learning aim CG4.

Personalized attention

Methodologies	Description
Master Session	Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study.
Autonomous troubleshooting and / or exercises	Students will have the opportunity to attend personalized tutoring in the schedule that teachers establish for this purpose at the beginning of the course and will be published in the course website. The teacher will resolve in the classroom the doubts that arise in the moment of the class and in the tutoring schedule those that arise when realising the autonomous study.

Assessment

	Description	Qualification
Laboratory practises	Performing lab practices that require instrumentation handling in which CG5 learning aim is assessed.	20
Presentations / exhibitions	Performing lab practices of software tools to search of information and a work about telecommunication regulation. Learning aims T3 and T15 are jointly assessed.	10
Troubleshooting and / or exercises	Proof in which the student has to solve a series of problems in a time and conditions established by the teacher, applying the acquired knowledge. Assessment of T4, T8, CG3 and CG4 learning aims.	40
Multiple choice tests	Tests for evaluation of acquired skills including direct questions about a particular aspect. Students must respond directly and briefly based on their subject knowledge. Learning aims T4, T8 and CG3.	30

Other comments on the Evaluation

Following the guidelines of the degree two evaluation systems will be offered: continuous assessment or final exam.

Continuous assessment includes a series of tasks performed during the course (70%) and a multiple-choice test (30%) performed on date according to the official exam schedule. To pass the subject by this evaluation system, 1/3 of the maximum score of each item in the above table must be obtained (except for the multiple choice test) and 50% minimum of the global score (sum of the four blocks) must be reached.

The tasks in the course include the active participation in ordinary classroom and laboratory sessions, autonomous working, information search, development and submission of a report and two tests of problem solving (the first scheduled at the middle of the term and the second by the end). These tasks are **not recoverable**, ie if a student cannot fulfill on time the teacher has no obligation to repeat them and will **only be valid for the academic year in which they are made**.

The students must decide if they choose the ongoing evaluation after the realization of the first test of problem solving on the 8 th - 9 th week of class, in which case they receive a grade that corresponds, independently that they present to other tasks or not. If the score is high as 50% without getting 1/3 in some of the items, the official grade will be 4.5

Evaluation by final exam

In addition to the continuous assessment system described above, the student may choose to perform one final exam that will have three parts:

- Part I: practice and report (pass or fail).
- Part II: multiple-choice test (40%).
- Part III: problem solving (60%).

It is necessary to pass the first part to be submitted to the other two. Obtaining a "fail" translates into a 2 official grade. If you have made the qualifying practices and the oral presentation of the report (essential) and have passed the third corresponding to, you do not need to perform the first part of the final exam.

July exam

It consists of a final exam with the same characteristics and weights as indicated in the previous section.

Students who want to preserve the grade obtained in the first tasks of the continuous assesment (70%) can elect to perform

only the multiple-choice test (30%) provided that minimum requirements had been got.

To pass the subject at least 50% in the total qualification must be obtained in any of the evaluation systems and calls.

Sources of information

F.T. Ulaby, **Fundamentals of Applied Electromagnetics**, 6^a,

S.M. Wentworth, **Applied electromagnetics. Early transmission line approach**, 1^a,

D. K. Cheng, **Fundamentos de electromagnetismo para ingeniería**,

Additional references:

B.M. Notaros, **Electromagnetics**, Pearson 2011.

N.N.Rao, **Elements of engineering electromagnetics**, Pearson, 6^a ed., 2004.

J.D. Krauss, **Electromagnetismo con aplicaciones**, McGraw-Hill 2000.

D. K. Cheng. **Field and Wave Electromagnetics**, Addison-Wesley, 2^a ed.,1989.

Recommendations

Subjects that continue the syllabus

Fundamentals of Sound and Image/V05G300V01405

Signal Transmission and Reception Techniques/V05G300V01404

Microwave Circuits/V05G300V01611

Radio Frequency Circuits/V05G300V01511

Spectrum Management/V05G300V01612

Optical Telecommunication Infrastructures/V05G300V01614

Wireless Systems and Networks/V05G300V01615

Radio Communication Systems/V05G300V01512

Subjects that are recommended to be taken simultaneously

Digital Signal Processing/V05G300V01304

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201

Physics: Fields and Waves/V05G300V01202

Mathematics: Calculus I/V05G300V01105

Mathematics: Calculus II/V05G300V01203
